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Pea and Bean Huller for Use in Locker and Community Canning Plants[1]

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CONTENTS

A SURVEY of 21 frozen-food locker plants in Georgia shows that only 15.2 percent of the produce handled was fruits and vegetables.[2] Many of the plant operators stated that the processing of vegetables was unprofitable in a locker plant because they were unable to purchase small-scale labor-saving equipment such as pea and bean hullers. Community canneries are likewise in need of small-scale processing machinery. To meet the equipment needs of such enterprises a cooperative research project was initiated in 1948. Among the objectives were: (1) To determine whether or not a small efficient pea and bean huller was available on the market; (2) to design, test, or adapt hullers for use in small processing plants; and (3) to determine the effect of this equipment on the food-processing program in rural communities.

PROCEDURE

Catalogs from leading manufacturers of food-processing machinery were reviewed. It was found that two types of small pea and bean hullers were offered for sale. These were: (1) A roll type which

[1] A report of work conducted cooperatively under the Research and Marketing Act of 1946 by the University of Georgia and the Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture. Credit is due Carl Brockseker, of the Bureau of Plant Industry, Soils, and Agricultural Engineering, for altering, adapting, and testing hullers.

[2] Bulletin, College of Agriculture, University of Georgia, Frozen-Food Locker Plants in Georgia, 1948, by H. D. White, W. M. Hurst, and W. E. Garner.

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squeezes the peas and beans from the pods between rollers, and (2) the viner type which employs the beating or flailing principle. The viner type was available in two sizes. Hullers of both types and sizes were purchased for use in making performance tests in a selected group of frozen food and community canning plants. This report deals only with the larger model of the viner type. Its capacity was better suited to the need of most plants than the smaller model. The viner type is similar to the large machines used by commercial canning and freezing plants for threshing green peas and bean vines, except that it is suitable only for shelling hand-picked pods. Such a machine is illustrated in figures 1 and 2.

On the basis of an engineering analysis it was decided that means should be provided for changing the speed of the beaters, depending upon the kind and condition of the product to be hulled. These

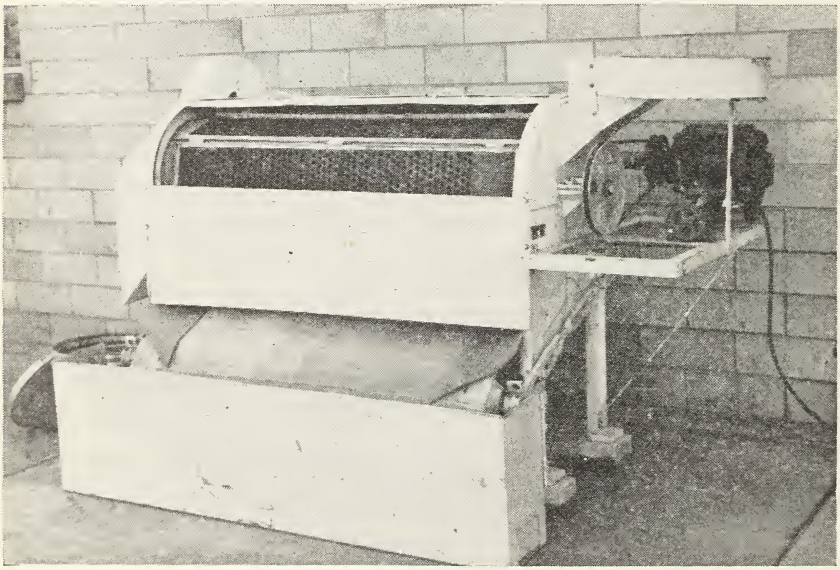

FIGURE 1.—Pea and bean huller with variable-speed control unit and ¾-hp. motor.

machines have a rotating perforated cylinder and paddles mounted on a shaft extending through the cylinder. The paddles flail the pods and beat them against wooden bars which project inside the cylinder. The cylinder and the paddles rotate in the same direction, but the paddles are driven at a much higher speed than the cylinder.

As the pods are shelled the beans or peas fall through the holes in the cylinder. The hulls move from the feed to the discharge end of the cylinder due to the pitch of the paddles. The canvas conveyor under the cylinder is adjustable as to angle. It travels upward on the top side and acts as a separator. The more or less round peas and beans roll down the canvas into a container. Particles of hulls and trash tend to lie flat on the canvas and are dumped on the opposite side of the machine from the shelled product.

A variable-speed drive, as shown in figure 1, was installed on the machine before field trials. No change was made in the speed ratio

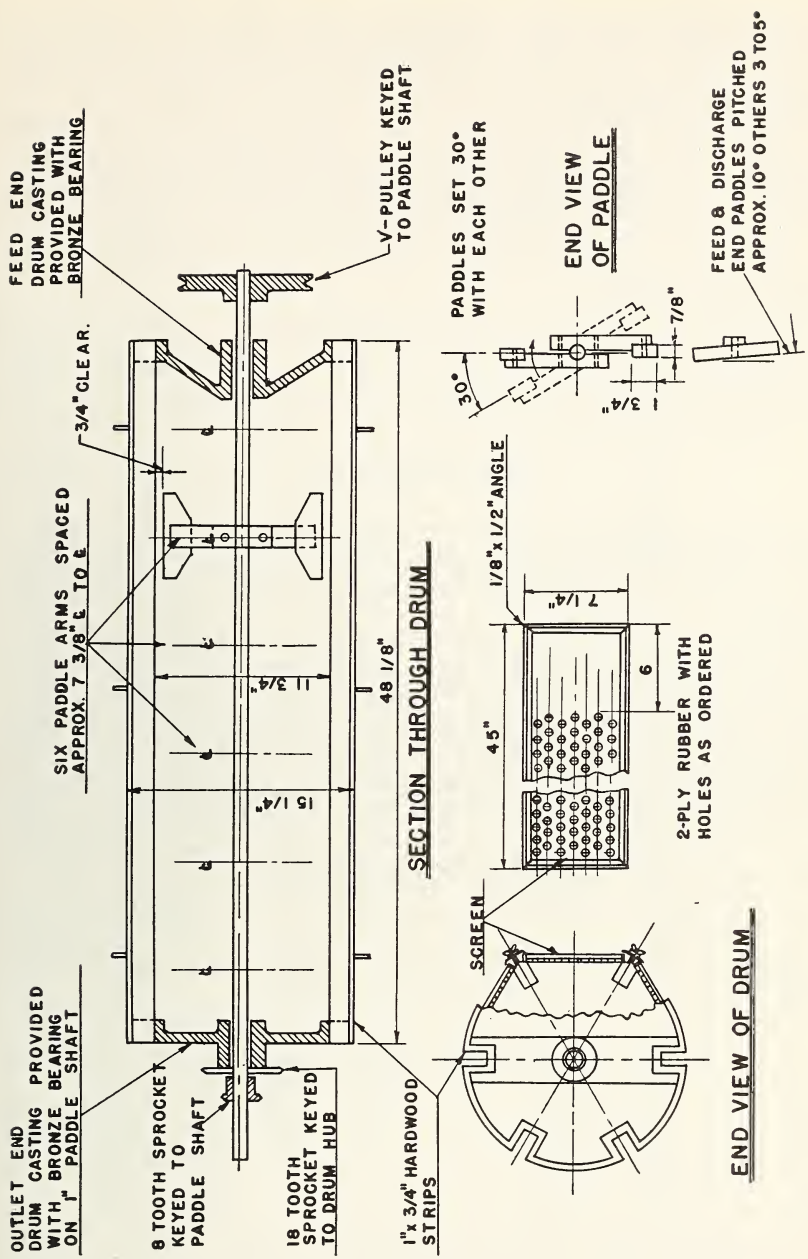

FIGURE 2.—Viner-type huller for shelling pods of beans and peas.

between the cylinder and paddles. The power used in operating the machine was measured, and a ¾-hp. motor was installed to replace the ⅓-hp. motor that came with the huller. This change provided a surplus of power except for high speeds and heavy loads.

The machine was tested under supervision at several plants. Later it was left in selected canning and freezer-locker plants for operation

by the management or patrons to obtain their opinion as to performance and adaptability. As a result of tests and discussions with operators and patrons the huller was returned to the laboratory from time to time for alterations.

A large hopper was constructed to replace the small one on the machine. The method of altering the angle of the canvas was simplified to save time in changing from peas to beans. Also, the sieve came from the factory in 6 sections held in place on the machine with 18 wing nuts. To save time in changing sieves for different crops the sections were hinged together and only 3 wing nuts used to hold them on the cylinder.

At the end of one season's work with the huller a trip was made to the factory to discuss possible changes in the machine to improve its performance. The manufacturer agreed to make the suggested changes on models for the 1949 season. Some tests made with the new machines are included in this report.

TEST RESULTS

Test data obtained by operating the machine in nine different plants indicate that the speed of the beater shaft should vary from about 400 to 600 r. p. m. and should be readily adjustable over that range of speeds.

The size of opening in the sieve is important. In general a ⅜-inch sieve should be used for Mush and Lady Finger peas, a ½-inch sieve for the average field and Crowder peas, and a ⅝-inch sieve for lima beans. These recommendations will vary somewhat in different localities and for different varieties of beans and peas. No tests were made with Fordhook lima beans, nor on garden peas. However, it is known that the machine will handle these crops. Referring to table 1, trial

TABLE 1.—*Performance test of huller with different lots of lima beans grown in Tift County, Ga.*

Pods (pounds)	Shelled by machine		Left in hulls		Total beans shelled	Yield	Speed	Sieve size
	Pounds	*Percent*	*Pounds*	*Percent*	*Pounds*	*Percent*	*R. p. m.*	*Inch*
18½	3	16. 2	3½	18. 9	6½	35. 1	385	⅝
18½	5¾	31. 1	¾	4. 1	6½	35. 2	450	⅝
18½	6	32. 4	⅓	1. 8	6⅓	34. 2	450	⅝
55¼	17¾	32. 1	-------	-------	17¾	32. 1	450	⅝
686	215	31. 3	-------	-------	-------	31. 3	450	⅝
67½	23	34. 1	-------	-------	-------	34. 1	450	⅝
253½	73	28. 8	-------	-------	-------	28. 8	450	⅝

runs indicated a beater speed of 450 r. p. m. for best results with the beans used. When the speed was increased from 385 to 450 the proportion of beans left in the hulls was reduced from 18.9 to 4.1 percent in one batch, and to 1.8 percent in another.

Table 2 shows the optimum speeds as determined by observation for the various types and lots of peas found in one canning plant in Emanuel County. It is interesting to note that some of the products had to be rerun because of the differences in the stage of maturity of the peas in the same batch.

TABLE 2.—*Performance tests of huller on different lots of field peas grown in Emanuel County, Ga.*

Crop	Pods	Shelled		Yield	Time required		Screen size	Speed of beaters
		First run	Second run					
	Pounds	*Pounds*	*Pounds*	*Percent*	*Min.*	*Sec.*	*Inch*	*R. p. m.*
Peas	34	10	-------	29. 4	11	0	½	543
Do	34	11	-------	32. 2	10	30	½	543
Do	68	25	-------	36. 7	20	0	½	519
Peas (Crowders)	30	12	-------	40. 0	9	45	½	519
Do	24	8	-------	33. 3	6	46	½	519
Do	14	6	-------	42. 8	5	32	½	519
Do	20	7	-------	35. 0	5	56	½	519
Do	41	14	-------	34. 1	10	49	½	519
Peas	96	25	5	31. 2	24	00	½	519
Peas (Crowders mixed)	49	15	-------	30. 6	13	52	½	519
Peas (Blue Hull mixed)	35	11	-------	31. 4	10	6	½	519
Peas	23	9	-------	39. 1	5	20	½	519
	23	8	-------	34. 8	7	40	½	519
Peas (too green)	26	6	1	27. 0	5	49	½	519
Peas	12	4	-------	33. 3	-------		½	510
Do	24	8	-------	33. 3	5	45	½	510
Do	25	6	-------	24. 0	5	40	½	500
Peas (too green)	24	4	-------	16. 6	5	23	½	500
Do	21	3	-------	14. 3	5	30	½	500
Peas (Mush)	21	3	-------	14. 3	5	30	⅜	538
Do	20	4	-------	20. 0	6	47	⅜	544
Do	19	3	3	31. 6	5	56	⅜	544
Peas (Lady Finger)	30	11	-------	36. 3	7	55	⅜	534
Peas (Lady Finger mixed)	35	12	4	45. 7	8	32	⅜	534
Peas (Crowders)	21	10	-------	47. 6	5	44	½	534
Peas (too green)	21	6	1	33. 3	6	12	½	534
Peas (mixed)	65	19	-------	29. 2	14	40	½	534
Peas (Red Hull Javis)	22	12	-------	54. 5	5	50	⅜	550
Do	21	11	-------	52. 4	5	25	⅜	550
Peas (white)	27	9	1	37. 0	6	40	⅜	550
Peas	45	16	-------	35. 5	10	35	⅜	485
Peas (Tanners')	28	6	2	28. 6	8	9	⅜	485
Peas (Lady Finger)	21	7	2	42. 8	8	24	⅜	485

In the picking of peas and beans little attention generally is given to the degree of ripeness, especially in the case of peas. This factor has much to do with the performance of the huller, because different speeds are desirable for different stages of maturity. Peas and beans of the same maturity are best for a high quality uniform product and efficiency in hulling.

It was later found that the same varieties of peas in northern Georgia differed from those in southern Georgia in the time required to run and in the percentage of yield.

The conclusion drawn here was that the operator should have a variable speed mechanism so that the speed could be set for the various conditions encountered. The average time required to shell a bushel of peas ranged from 3 to 10 minutes.

TABLE 3.—*Performance tests of huller on different lots of lima beans grown in Clarke County, Ga.*

Pods (pounds)	Shelled	With hulls	Total	Yield	Sieve size	Time	Speed of beaters
	Pounds	*Pounds*	*Pounds*	*Percent*	*Inch*	*Minutes*	*R. p. m.*
178.7	75. 5	4. 2	79. 9	44. 7	5/8		510
57.0	15. 5	1. 0	16. 5	28. 9	5/8		510
40.0	13. 5	. 5	14. 0	35. 0	5/8	9. 0	510
48.5	14. 0	3. 0	17. 0	35. 1	5/8	7. 0	510
12.0	4. 5	. 1	4. 6	38. 3	5/8	4. 0	510
26.0	10. 0	. 1	10. 1	38. 8	5/8	8. 0	510
44.5		. 5			5/8	13. 5	510

Table 3 shows results of tests on lima beans in Clarke County. The time required ranged from 5 to 10 minutes per bushel. The operators and patrons who used the machine were well pleased with its performance. As a general rule the efficiency of this machine is higher on lima beans (butter beans) than on field peas.

TABLE 4.—*Performance tests of huller on different lots of beans and peas grown in Stephens County, Ga.*

Crop	Pods	Shelled	Yield	Time	Size of screen	Speed
	Pounds	*Pounds*	*Percent*	*Min.*	*Inch*	*R. p. m.*
Lima beans (mixed)	102	43. 0	42. 2	25	5/8	550
Do	92	27. 0	29. 3	40	5/8	
Do	148	46. 5	31. 4	44	5/8	490
Lima beans (white)	27	9. 5	35. 2	10	5/8	490
Peas (Crowder type)	56. 5	15. 5	27. 4		1/2	450
Second run		8. 5	15. 0		1/2	550
Total	56. 5	24. 0	42. 4			
Peas (Crowder)	47. 0	13. 75	29. 3	14	3/8	500
Second run		5. 5	11. 7	8	3/8	590
Total	47. 0	19. 25	41. 0	22		

Table 4 shows the results of some tests made during 1949 in northern Georgia. Results of these and subsequent tests, with results similar to those obtained in 1948, showed that the variable speed was an important factor in efficient operation. The two lots of field peas were

run a second time because of differences in maturity. The speed of the machine was increased for the green pods that did not shell on the first run.

Pitch and Clearance of Paddles Important

Table 5 shows the degree of pitch on 8 hullers in different sections of Georgia. Two of these machines had just been shipped from the factory. It is interesting to note that no two machines had the same paddle arrangement as to pitch. The recommended pitch for the paddles is given in the last line of table 5.

Table 5.—*Pitch of paddles from feed to outlet end as measured on 8 hullers*

Machine No.	Paddles					
	1st pair	2d pair	3d pair	4th pair	5th pair	6th pair
	Degrees	*Degrees*	*Degrees*	*Degrees*	*Degrees*	*Degrees*
1	8– 6	0–2	7– 0	3–8	8– 6	18–10
2	8–16	8–0	0– 8	3–8	0– 8	12–12
3	8–16	0–8	0–16	3–3	3–16	10– 2
4	16–16	8–2	3– 3	10–0	2– 2	4– 4
5	10–16	4–6	0–10	0–2	8– 6	6– 4
6	16–16	2–2	4– 4	0–4	4– 4	4– 4
7	16–16	11–4	4–10	8–4	8–10	8–10
8	16–16	4–4	0– 8	11–4	0– 8	4– 4
Recommended	10–10	5–5	3– 3	3–3	5– 5	10–10

The distance maintained between the rib or concave and the end of the paddles had an important bearing on the efficiency of operation (table 6). Too much clearance necessitated high speed operation to hull the beans. This caused considerable breakage and resulted in trash and an inferior product passing through the sieve and

Table 6.—*Pitch of paddles and distance between ribs and paddles as measured on 3 hullers*

Machine No. 1			Machine No. 2			Machine No. 3		
Paddles		Paddle clearance	Paddles		Paddle clearance	Paddles		Paddle clearance
Pairs	Pitch		Pairs	Pitch		Pairs	Pitch	
	Degrees	*Inch*		*Degrees*	*Inch*		*Degrees*	*Inches*
1	3–16	9/16–9/16	1	10–5	3/4–1/2	1	10–5	1–1
2	5– 3	9/16–5/8	2	6–7	3/4–7/8	2	7–6	1–1 1/4
3	6– 0	5/8 –11/16	3	8–0	3/8–5/8	3	0–8	1–1
4	3– 2	1/2 –1/2	4	1–8	1/2– 11/16	4	8–3	1–7/8
5	6– 3	5/8 –11/16	5	0–0	5/8–1/2	5	7–5	1–1
6	0– 4	3/4 –5/8	6	7–5	3/4–7/8	6	5–7	1–7/8

into the receiving pan. Too little clearance mashed the shelled beans and resulted in a damaged product.

It was found that machines with a clearance of approximately ¾ inch between the concave and the paddles did the best job on both field peas and lima beans. The wide clearance between the concave and the paddles was generally due to wear on the lower edges of the paddles. This condition should be corrected periodically by installing new paddles.

Too little clearance was usually found to be in the middle of the cylinder due to sagging of the wooden concave bars. It can be corrected by rods or spacers through the middle of the cylinder between opposite bars.

INCOME FROM HULLERS

The purpose of table 7 is to serve as a guide in determining the feasibility of owning and operating a huller of the type and size shown in figure 2, as an integral part of a community canning plant. The plants selected are typical of those in Georgia.

Considering 1949 as an average year in the community canning business there was skepticism expressed by the operators questioned as to whether this machine would pay for itself from service charges. They considered the cost of the machine out of proportion to the service rendered. However, it must be realized that 1 or 2 years' operation of a machine in a community is hardly a fair test of its power to draw extra peas and beans into the processing line or to increase acreage for processing. Also, such a short period is insufficient to get either conclusive or complete data as to the effect of the machine on the total volume of products processed.

Adverse weather conditions during 1949 resulted in high prices for fresh vegetables and a decrease in canning for home use. Commercial pack was available and the regular and prospective patrons had not been shown the value and efficiency of labor-saving equipment in the processing of home-grown vegetables. Despite unfavorable operating conditions during the 1949 season machines at the four plants in table 7 returned interest on the investment ranging from about 7.6 to 33.3 percent. Several locker plants reported hullers as a profitable investment.

Complaint was general as to the waste of shelled beans and peas with the hulls. The percentage of waste from the huller is no greater than threshed grain in the straw from a combine, but it is more noticeable.

The quality of the product from properly adjusted and operated machines was satisfactory to the patrons. More time was required to remove fragments of pods and trash from peas or beans shelled by machine than from those shelled by hand. This job was of little concern to patrons because of the time saved in shelling. Only a few minutes were required to shell a bushel of peas or beans with the machine as compared with several hours by hand.

The machine ruptured the skin on some beans and peas and some were discolored by juices from the pods. These were not suitable for sale as shucked green peas and beans. However, after the product was washed and blanched for freezing or canning there was little difference in appearance between the beans and peas shelled by machine and those shelled by hand.

TABLE 7.—*Survey of canning plants in southern Georgia and the effect of a huller on plant income*

Plant No.	Screens		Patrons served by—		Pods shelled		Charges	Income from huller	Remarks by operator
	No.	Size	Huller	Plant	Peas	Beans			
		Inch	*Number*	*Number*	*Pounds*	*Pounds*		*Dollars*	
1	2	½–⅝	125	300	4,000	4,000	1 cent per pound	80.00	Too many shelled beans and peas go over with hulls.
2	3	⅜–½–⅝	56	[1]	1,665	3,855	25 cents per bushel	45.98	Recover shelled beans and peas from hulls. Huller would not pay for itself on peas.
3	2	½–⅝	74	175	1,761	3,269	1⅓ cents per pound	67.07	Need cheaper screens, more adjustments on canvas.
4	2	½–⅝	200	[1]	5,000	5,000	2 cents per pound	200.00	Need cheaper machine.

[1] Data not available.

CONCLUSIONS

1. Beans and peas should be picked as near the same ripeness as possible.
2. Degree of ripeness and variety affect the yield of shelled peas or beans and the performance of the huller.
3. The speed of the paddles should be readily adjustable from 400 to 600 r. p. m.
4. The pitch of the paddles has an important bearing on the satisfactory operation of the huller.
5. The distance between the paddles and the concaves is important.

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